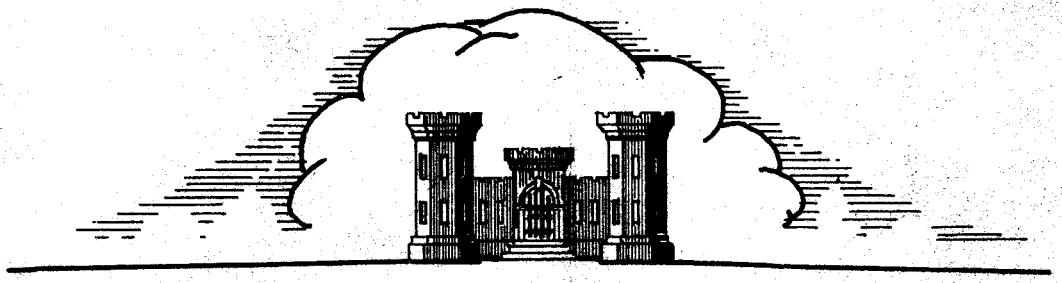
CONNECTICUT RIVER FLOOD CONTROL PROJECT

WINSTED CHANNEL IMPROVEMENT

MAD RIVER, CONN.

DEFINITE PROJECT REPORT



WAR DEPARTMENT CORPS OF ENGINEERS U. S. ARMY
U. S. ENGINEER OFFICE PROVIDENCE, R. I.

JULY 1944

14

War Department
United States Engineer Office
Providence, Rhode Island

CONNECTICUT RIVER FLOOD CONTROL PROJECT

DEFINITE PROJECT REPORT

MAD RIVER CHANNEL IMPROVEMENT

WINSTED, CONNECTICUT

July 1944

DEFINITE PROJECT REPORT
MAD RIVER CHANNEL IMPROVEMENT
WINSTED, CONNECTICUT

C O N T E N T S

INCLOSURES

Dwg. File No. CT-3-1233, Revision A
Map of Drainage Area
15 Photographs with Index

War Department
United States Engineer Office
Providence, Rhode Island

CONNECTICUT RIVER FLOOD CONTROL PROJECT

DEFINITE PROJECT REPORT
MAD RIVER CHANNEL IMPROVEMENT
WINSTED, CONNECTICUT

July 1944

Project Authorization

1. Authority. - Flood Control Act approved 18 August 1941 (Public No. 228, 77th Congress, 1st Session).

Previous Investigations

2. House Document No. 724. - House Document No. 724, 76th Congress, 3d Session. This document contains the following statement: "At Winsted, Conn., it is proposed to improve the channel of Mad River. The estimated cost of this improvement is $140,000 for construction and $3000 for lands and rights-of-way, a total of $143,000." The above statement was based upon investigations made by the District Engineer in connection with the "Review of Reports on Flood Control" submitted by him to the Chief of Engineers on 28 February 1940 and now undergoing revision.

Location and Description of Area Affected

3. Description of Mad River. - The Mad River rises in the vicinity of the village of Summit, Norfork Township, Connecticut at elevation 1300 M.S.L. and flows generally east southeast to its confluence with the Still River at Winsted, a total distance of 8.7 miles. The elevation of the confluence of the Mad and Still Rivers is 690.± M.S.L. Above Winsted,

water from the Mad River is diverted into Rugg Brook Reservoir (water area 45 acres) and Crystal Lake (water area 150 acres) for water supply of Winsted and vicinity. Overflow from the latter flows into Highland Lake (water area 490 acres) which is controlled for a privately operated hydroelectric power plant. The outlet from Highland Lake enters Mad River just above Lake Street Bridge. The drainage area above Lake Street Bridge is 32.8 square miles; the terrain is rugged with little or no natural storage other than the lakes noted above thus tending to produce rapid runoff.

4. Description of City of Winsted. - The City of Winsted is located in approximately the center of the Township of Winchester, Litchfield County, Connecticut at the confluence of the Still and Mad Rivers. Its population in 1940 was 7674. This city is primarily a market center for the surrounding rural population although a few manufacturing plants are situated within the borough limits.

5. Description of Area to be Protected. - The area affected by floods and under discussion in this report is within the limits of Winsted from river mile 0.60 to river mile 1.20. In this area Main Street, the shopping center of Winsted, parallels and is approximately 30 feet north of and 6 feet above the riverbed. From above Lake Street Bridge to below Case Avenue Bridge the buildings fronting the south side of Main Street are constructed wall-to-wall, and are set on cantilever beams overhanging the riverbed from 6 to 12 feet. In a few cases these buildings span the river, effectively constricting the flood channel. Two obsolete dams which were formerly used to provide head for water used in manufacturing plants are the main cause of of the river overflowing its banks during extreme high water periods. Within the project reach the river is approximately 40 feet wide. The stream is fast flowing, the riverbed is generally boulder strewn and contains considerable

deposits of debris. With very few exceptions the river bank consists of dry masonry walls, the foundations of which apparently extend to existing grade only. These walls are in a poor state of repair and show little or no evidence of proper maintenance.

Recommended Project Plan
(The Definite Project)

6. The Definite Project. - The definite project plan for the flood protection of the City of Winsted proposes:

a. Improving the river channel from Lake Street Bridge (river mile 1.20) to a point 1600 feet below Case Avenue Bridge (river mile 0.60); this channel improvement to consist of (1) excavation of debris and other materials to provide a cross-section of such area as will permit a minimum of two feet of freeboard between the centerline elevation of Main Street and the design flood profile, (2) riprapping the channel as required.

b. Removing the two obsolete dams.

c. Constructing a concrete channel lining to prevent scour under the garage of the Winsted Motor Sales Co. (river mile 0.87) and the warehouse of the Manchester Grain Mill, Inc. (river mile 0.85).

d. Removing one pier under the Manchester Grain Mill warehouse and replacing same with a structural steel and concrete pier carried to a suitable foundation below the proposed channel grade.

7. Channel Capacity. - Hydraulic investigations indicate that the maximum discharge capacity which can be maintained with practicability and still provide for the two feet of freeboard below Main Street is 5000 cubic feet per second. It is therefore considered practicable to limit the channel improvements to:

a. Removing accumulations of channel debris which seriously interfere with free flow.

b. Razing the two existing dams which constitute the most troublesome obstructions to flow.

It is considered inadvisable to disturb the original riverbed of thoroughly consolidated boulders and heavy gravel anymore than absolutely necessary as this procedure would be hazardous to existing foundations of walls and buildings which local interests desire to retain intact. Details of the proposed improvement as indicated in this and the preceding paragraph are shown on Plate I attached.

8. Hydrology.

a. Scope of Hydrological Studies. - The hydrological studies contained in this report are directed primarily toward determining the maximum rate of discharge of a design flood for use in design of the channel improvement. A design flood having a peak rate of discharge of 5,000 cubic feet per second was selected as being one which will provide protection against floods 50% larger than the maximum flood of record which occurred in September 1938 and the largest practicable flood discharge from the standpoints of physical and economic feasibility.

b. Drainage Areas. (See Plate II). - As planimetered from the U. S. Geological Survey topographic sheets the drainage area above the Lake Street Bridge, which is the upstream limit of the proposed improvement is 32.8 square miles. From the same source the drainage area tributary to the lower limit of the improvement is 33.6 square miles and the drainage area at the confluence with the Still River is 33.7 square miles. Water supply and power developments on the Mad River drainage area involve lake storage that may, at times, affect the discharge through Winsted. For water supply purposes the City of Winsted has constructed a diversion dam on the Mad River about 1/2 mile above the mouth of Rugg Brook. From this diversion dam, which has no significant storage pool, a diversion canal diverts water into a small reservoir on Rugg Brook. This

reservoir has an area of 45 acres and no significant amount of storage with respect to flood control. From the Rugg Brook reservoir water is diverted by an unlined 6 ft. x 6 ft. tunnel to Crystal Lake, which is indicated as Little Pond on the U. S. Geological Survey Sheets, whence it is piped to the City of Winsted as a public water supply.

Crystal Lake has an area of 150 acres and a drainage area of 0.68 square miles. This lake is operated for water supply purposes and consequently will be maintained as full as stream flow will permit. It may at times, however, be effective to a minor extent in reducing flood discharges through Winsted.

The overflow from Crystal Lake discharges through Sucker Brook into Highland Lake which has an area of 490 acres and an independent drainage area of 6.62 square miles. The flow from Highland Lake is controlled for power purposes, being utilized by seven plants along the brook which connects Highland Lake with the Mad River just above the proposed channel improvement. Available storage in Highland Lake may at times be sufficient to practically control flood runoff from its own watershed plus the overflow from Crystal Lake. The Winsted Flood Control Committee stated that this was the case in the flood of March 1936 and estimates by the U. S. Geological Survey District Engineer indicate that this area contributed only 100 c.f.s. to the peak rate of discharge during September 1938. Each foot of depletion in Highland Lake will provide storage for approximately 1-1/2 inches of runoff from the drainage area of 6.62 square miles.

c. Rainfall.

(1) Rainfall Stations. - No rainfall station is located on the Mad River watershed but two are located in close proximity. A non-recording gage was maintained at Norfolk, about one mile west of the drainage area from July 1915 to September 1941. This was changed to a recording gage at another location near Norfolk in September 1941 and this gage has been maintained since that date. A non-recording gage has been maintained at the Peoples Forest Ranger Station about 3 miles east of Winsted since January 1936.

(2) Storm Rainfall. - The maximum storm of record is that of September 17-21, 1938. During this storm 11.19 inches of rainfall fell at the Peoples Forest (then Camp White) gaging station and 11.13 inches fell at the Norfolk station. A mean for the Mad River watershed established by averaging the mass diagrams for the two stations amounted to a total of 11.1 inches on the watershed in a period of about 72 hours. The first 54 hours rainfall amounted to about 6.5 inches fairly uniformly distributed over the period at an average rate of 0.12 inch per hour. This thoroughly saturated the ground and reduced infiltration to a minimum during the last 20 hours during which 4.6 inches of rain fell at an average rate of 0.23 inch per hour. It was this last period of rainfall that caused a flood peak in the Mad River through Winsted estimated at 3,300 c.f.s. by the U. S. Geological Survey. This peak occurred in the evening of September 21st.

Second in magnitude with respect to the flood peak produced is the storm of March 1936. The peak rate of discharge of the Mad River during this storm is known to be considerably less than for September 1938 but its magnitude is not known. The flood resulted from a combination of rainfall and melting snow.

According to area-depth envelope curves based on analysis of the September 1938 storm 16.4 inches of rain could have fallen on the Mad River drainage area in 48 hours of the most intense portion if the storm had occurred over the area. By use of a derived unit hydrograph it has been estimated that such a storm would produce a peak rate of discharge of approximately 14,000 c.f.s. in the Mad River at Winsted. This rate of discharge is excessive for use as a design flood as it would occur at such infrequent intervals that the annual benefits would be materially below the annual costs. Construction costs would be out of proportion to those due to the adopted design flood because it would be necessary to remove the present rubble masonry retaining walls and replace them with walls having deeper foundations to permit constructions of a deeper channel.

d. Runoff. - As previously stated there are no stream gaging stations in the Mad River and other information on which to base a study of runoff is meagre. High water marks are available for the September 1938 flood but the complications of overbank flooding and hurricane debris make these unsatisfactory for any reliable computation of the maximum rate of discharge. The best estimate of the discharge of the Mad River during this flood, made by the District Engineer of the U. S. Geological Survey, places the maximum rate of discharge of the Mad River at 3,300 cubic feet per second. It was based on the flow over the dam of the Gilbert Clock Co. on the Still River about 3/4 mile below the mouth of the Mad River. The maximum rate of discharge at the Gilbert Clock Co. dam was computed at 3,700 c.f.s. Of this amount 400 c.f.s. was estimated as coming from the Still River and 3,300 c.f.s. from the Mad River. A maximum of 100 c.f.s. is known to have come from Highland Lake which controls 7.3 square miles in the Highland Lake and Crystal Lake drainage areas. Thus the remaining 3,200 c.f.s. came from the remaining 26.4 square miles of the Mad River drainage area. This amounts to 121.2 cubic feet per second per square mile. If the whole Mad River watershed had been contributing at this rate the maximum rate of discharge at the Lake Street Bridge would have been 3,975 c.f.s. and at the mouth of the Mad River 4,085 c.f.s. or a mean of about 4,000 c.f.s. for the reach in which channel improvement is proposed.

e. Design Flood. - A design flood having a maximum rate of discharge of 5,000 cubic feet per second for the reach of the river included in this project was selected for design of the improved channel. This peak is 50% larger than the estimated discharge of the maximum known flood of September 1938 and 25% larger than the maximum possible discharge that might have occurred during this flood if Highland Lake had been full at the time.

A controlling factor in selecting 5,000 c.f.s. as the design discharge was the fact that it is the maximum discharge that can be provided for without involving expensive construction that would result in an unfavorable cost benefit ratio.

Improvement of the existing channel can be effected to enable it to carry 5,000 c.f.s. without removal of the present retaining walls or buildings along the banks. To provide for a materially larger rate of discharge would require a deeper and possibly wider channel. To deepen the channel beyond the limits shown in this project report would require that the present retaining walls be removed and replaced with new walls having their foundations at lower elevations. Otherwise deepening of the channel would undermine the present walls and cause their collapse. Removal and replacement of the retaining walls along the channel would be expensive because of the restricted and not easily accessible nature of the channel and because of the buildings located along the banks and this additional expense would result in an unfavorable cost-benefit ratio. Hence a design discharge of 5,000 c.f.s. was selected.

Engineering Features

9. Grades and Cross-Sections. - The proposed grades of the finished excavation are computed to pass the design flood with a minimum of two feet of freeboard below Main Street and to allow free flow under the various structures spanning the river. In general the cross-section provides for an undisturbed berm at least five feet wide at the foot of each wall to reduce the tendency of undermining these walls by scouring velocity of flood flow. The width of the bottom of the channel is established at seven feet and the side slopes do not exceed one on two and one-half. The actual cross-sections were determined from detailed hydraulic studies. Special consideration is required under the garage of the Winsted Motor Sales Company at river mile 0.87, and the Manchester Grain Mill warehouse at river mile 0.85. Due to the constriction caused by the abutments of these buildings it is necessary that the berm be omitted, the side slopes be increased to one on one and the channel be provided with a concrete lining to minimize all tendencies to scour. This proposed construction is indicated on Section 19-B, Plate I. To obtain the required cross-sectional area under the warehouse of the Manchester Feed Mill, Inc. at river mile 0.85, it is also necessary that one of the existing piers be reconstructed to

greater depth as the proposed channel grade at this point is below the foundation of the present pier. This modification is shown on Section 18, Plate I.

10. Channel Protection. - To prevent all possibilities of scour in the riverbed it is proposed to line all excavated areas with hand-placed riprap, except as noted in Paragraph 8 above. In addition it is proposed to grout all riprapped slopes immediately above and below the concrete lined areas where the slope exceeds one on two and one-half.

11. Geologic Investigations. - Investigations of the geologic conditions of the riverbed consisted of probings at fifteen points along the reach of the river between Lake Street Bridge and Case Avenue Bridge. These probings together with observations of the stream bed indicate that the river between Case Avenue Bridge (river mile 0.60) and Bridge Street Bridge (river mile 0.75) flows over fairly compact to very compact gravels, cobbles and boulders. Between Bridge Street Bridge and Lake Street Bridge (river mile 1.20) ledge outcrops of banded gneiss are evident at several points. Due to the soundness and massiveness of this material, excavation will be difficult. Considerable amounts of compact gravels, cobbles and small boulders on the upper section of the reach in question will require hand excavation methods to remove.

12. Construction Difficulties. - Removal of excavated material from the Mad River Channel will be difficult. This channel is enclosed on both sides by vertical walls from four to eight feet high and except for a short stretch of approximately 200 feet at river mile 0.88 the buildings on the north bank are built wall-to-wall, overhanging the river from six to twelve feet in a majority of cases. Clearance under these buildings averages six feet. The south bank is not as closely built-up but is heavily wooded with a steep bank and retaining walls rising 30 to 50 feet above the riverbed. It will therefore be undoubtedly necessary to adopt out-of-the-ordinary methods of excavation to carry materials along the riverbed to the few points accessible to the adjacent roads. The problem is further complicated by the impossibility of diverting the normal flow and the

difficulty of impounding the stream flow for even short periods of time. The use of a slack line excavator with its attendant high installation costs is indicated, this rig should work in conjunction with bulldozers in the riverbed and a crane at the end of the cableway to rehandle to the trucks. Blasting operations must be carefully handled to prevent damage to structures along the river bank. These difficulties can be visualized by an examination of the photographs enclosed with this report.

Estimate of Cost

13. Estimated Cost. - The estimated cost for the completion of this project is as follows:

Item No.	Item	Quantity	Unit	Unit Cost	Amount	Total
1	Construction Costs					
	Excavation, common	14,500	c.y.	3.00	$43,500	
	Excavation, rock	2,000	c.y.	4.50	9,000	
	Concrete channel lining	200	c.y.	20.00	4,000	
	Removing existing structures		L.S.		6,500	
	Reconstruction of pier		L.S.		3,550	
	Riprap, hand placed	2,000	c.y.	6.00	12,000	
	Grouting riprap	300	s.y.	1.50	450	
						$79,000
	Contingencies		20%			16,000
						95,000
	Engineering & Overhead		15%			14,000
	ESTIMATED CONSTRUCTION COST TO THE UNITED STATES					$109,000
2	Rights of Way, Lands, and Damages					
	Land	5 acres	L.S.		$ 500	
	Water rights, developed		L.S.		2,000	
					2,500	
	Legal, overhead and general expenses				500	
	ESTIMATED COST TO LOCAL INTERESTS					$3,000
	TOTAL ESTIMATED COST					$112,000

Miscellaneous

14. Results Expected. - The proposed Mad River Channel Improvement is expected to afford protection against flood damage for approximately 82 business and commercial establishments along Main Street, Winsted Connecticut. The assessed valuation of the property to be protected is in excess of $1,500,000. The total direct losses attributable to the 1938 flood, maximum of record, were estimated at $53,000.

15. Local Cooperation.

a. The City of Winsted has gone on record as being willing and able to cooperate to the limited extent necessary to obtain all lands and rights-of-way and to pay all costs of damages to water rights caused by the proposed improvements.

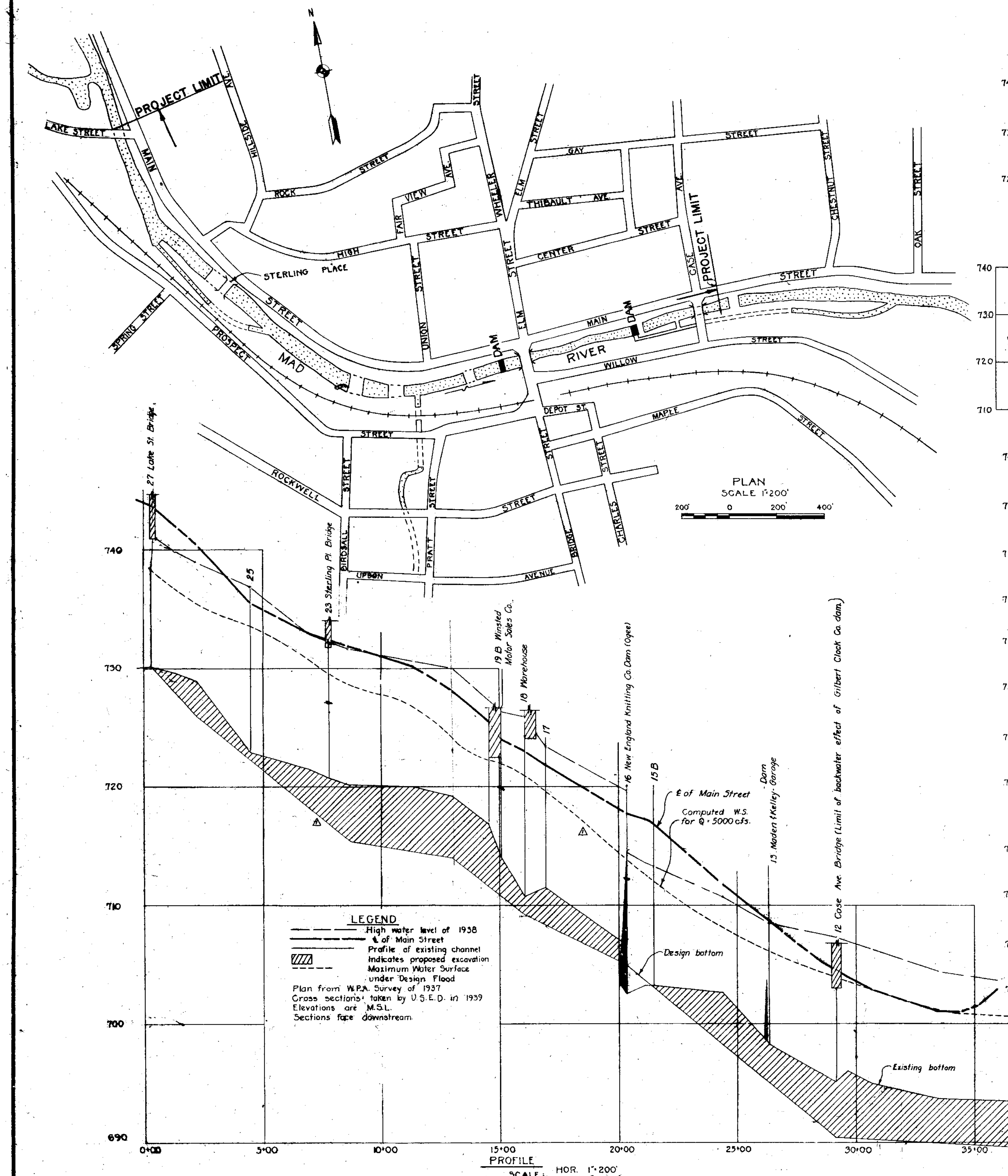
b. It is believed that the city has both the legal authority and the financial ability to meet their responsibilities in connection with this project.

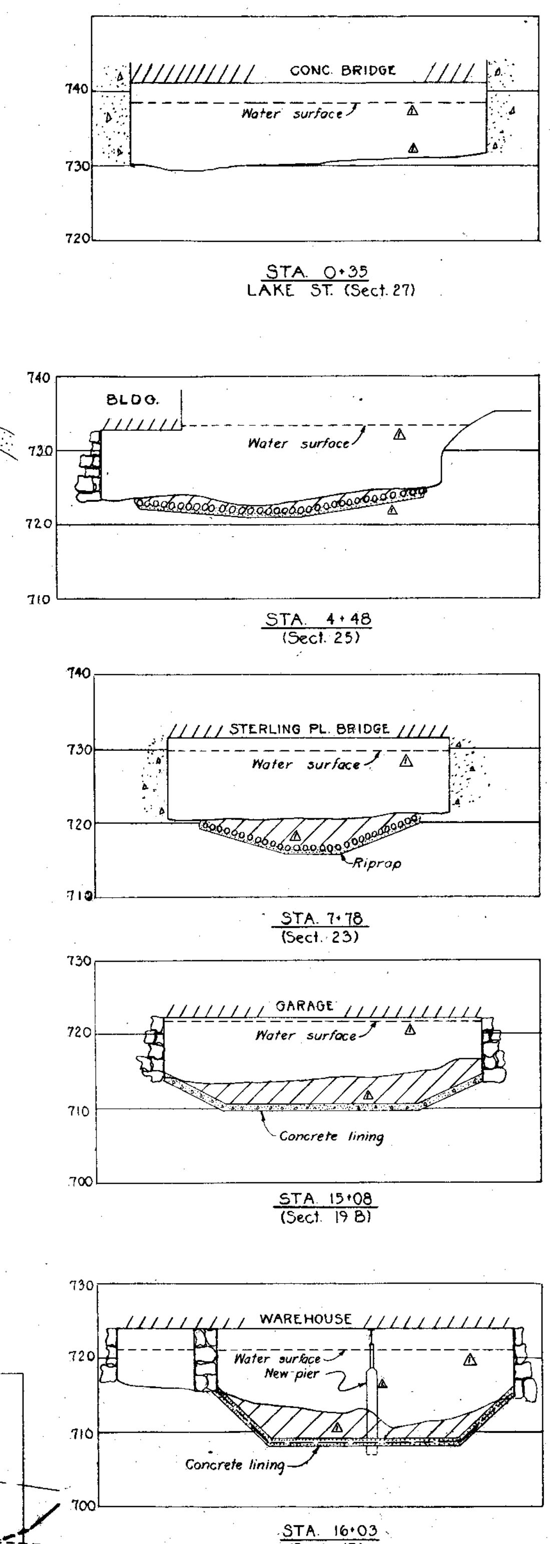
c. The best available estimate of cost of lands, damages, etc. to be borne by local interests is $2,500 with an additional $500 to cover legal and other incidental costs. This estimate was prepared for the Review of Reports of 28 February 1940 noted in Paragraph 2 above.

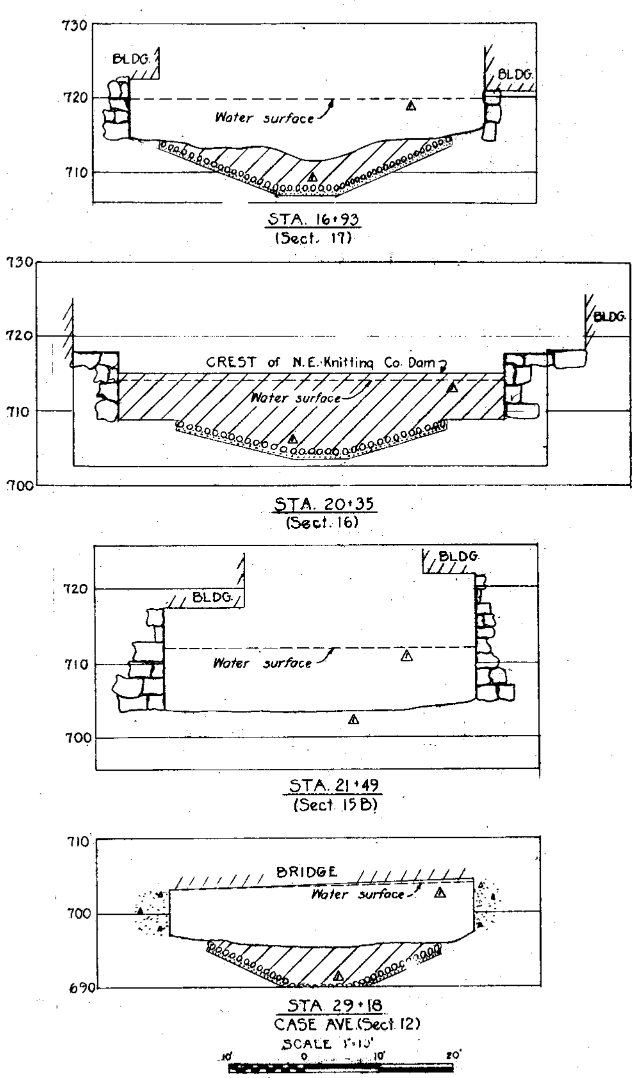
16. Time required for Construction. - It is estimated that four months will be sufficient to complete all work required under this project which period must be selected to coincide with the low flow period of the Mad River.

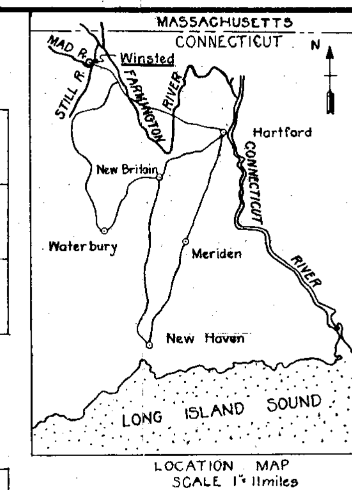
W. J. TRUSS
Colonel, Corps of Engineers
District Engineer

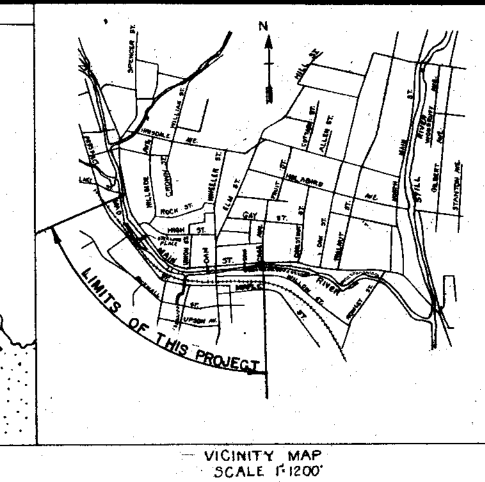
Inclos:
Dwg. File No. CT-3-1233, Revision A.
Map of drainage area
15 Photographs with Index











KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	AP. BY
△	6/27/44	Profile and sections revised			

CONNECTICUT RIVER FLOOD CONTROL
CHANNEL IMPROVEMENT
PLAN, PROFILES AND SECTIONS
WINSTED CONNECTICUT

MAD RIVER — CONNECTICUT

IN SHEETS — SCALE AS SHOWN — SHEET NO.

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., JUNE, 1944

SUBMITTED: PROJECT ENGINEER — APPROVAL RECOMMENDED: ENGINEER; HEAD ENGINEER, CHIEF, ENGINEERING DIV. — APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

PREPARED: PROJECT UNIT — DRAWN: F.C.W. — TRACED: — CHECKED:

FILE NO. CT-3-1233

Contour interval 20 feet.

Datum is mean sea level.

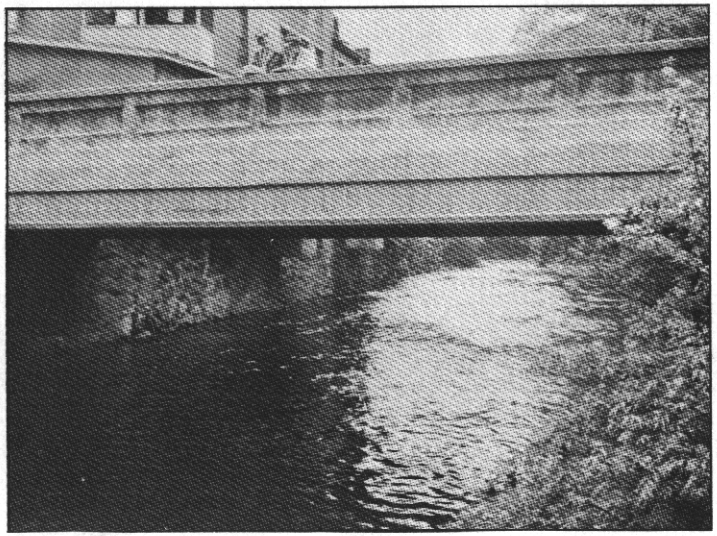
MAD RIVER
DRAINAGE AREA

PLATE NO. II

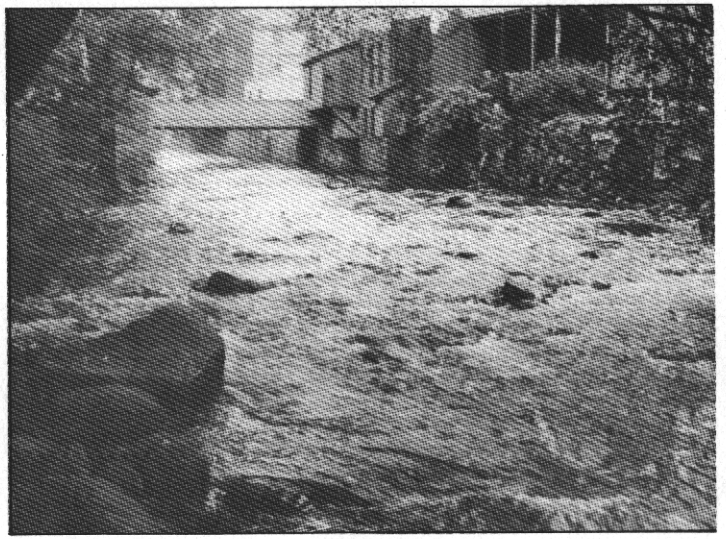
DEFINITE PROJECT REPORT
MAD RIVER CHANNEL IMPROVEMENT
WINSTED, CONNECTICUT

INDEX OF PHOTOGRAPHS

#1 LAKE STREET BRIDGE from abutment of grain company on right bank.
#2 UPSTREAM TOWARD LAKE STREET BRIDGE from right bank above Sterling Place.
#3 UPSTREAM VIEW from right bank above Sterling Place showing typical overhanging building and dumped refuse.
#4 FOOTBRIDGE from upstream below Sterling Place Bridge.
#5 UPSTREAM FROM FOOTBRIDGE showing dry masonry walls and overhanging buildings. Sterling Place Bridge and Colt Co. Store spanning river.
#6 DOWNSTREAM FROM FOOTBRIDGE showing island and Winsted Motor Sales Garage spanning river.
#7 WINSTED MOTOR SALES GARAGE from left bank showing constriction of channel. High water mark in 1938 flood was 8" more or less above window sills.
#8 WINSTED MOTOR SALES GARAGE from downstream.
#9 NEW ENGLAND KNITTING COMPANY DAM from Bridge Street Bridge.
#10 BRIDGE STREET BRIDGE from right abutment of New England Knitting Co. dam.
#11 DOWNSTREAM FROM BRIDGE STREET BRIDGE.
#12 DAM ABOVE MADIN AND KELLEY GARAGE.
#13 UPSTREAM VIEW from window of Madin and Kelley Garage.
#14 MADIN AND KELLEY GARAGE with dams in background.
#15 CASE AVENUE BRIDGE from upstream.

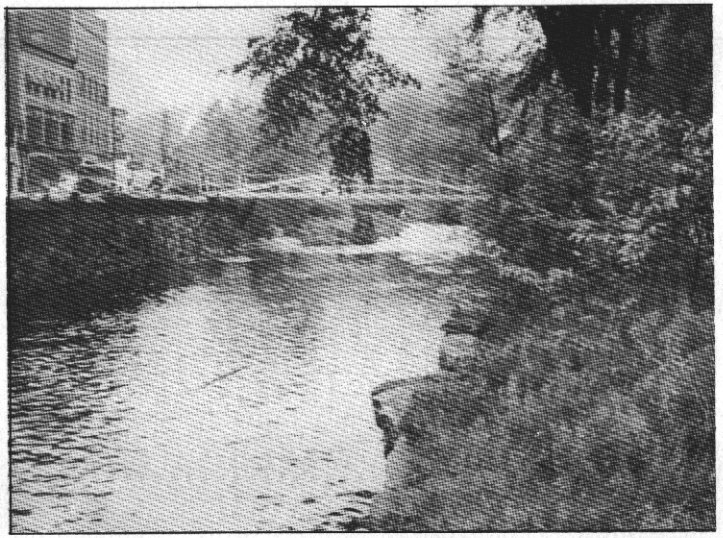


NO. 1 LAKE ST. BRIDGE

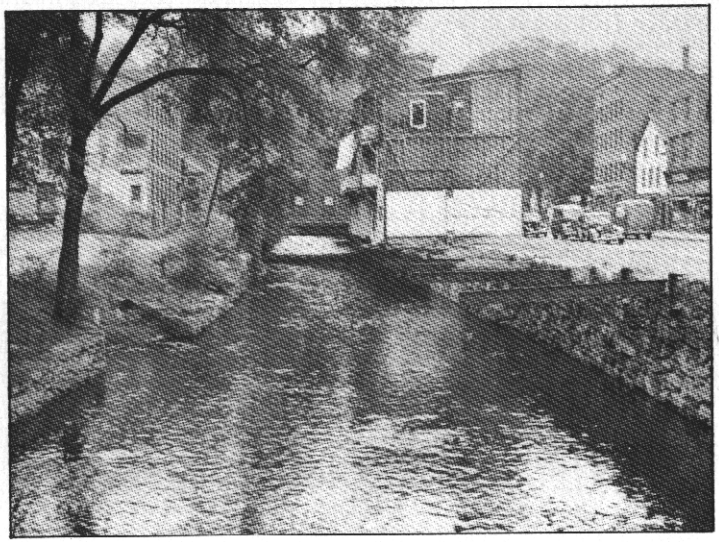


NO.2 UPSTREAM TOWARD LAKE ST. BRIDGE

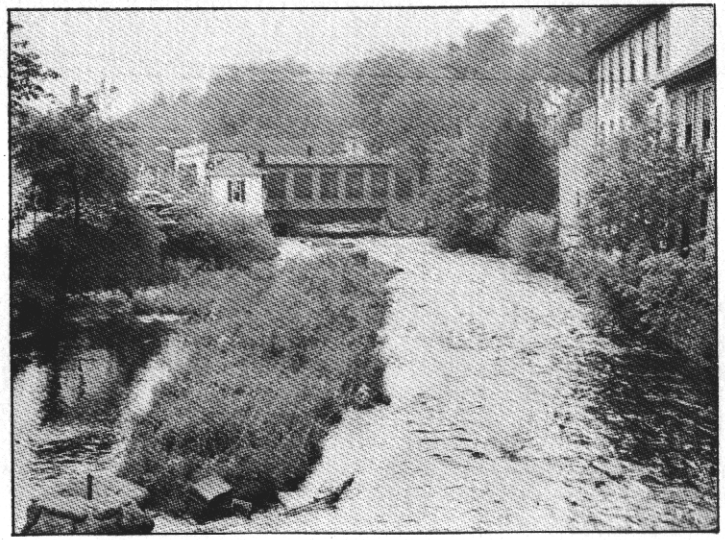
NO. 3 UPSTREAM VIEW



NO. 4 FOOTBRIDGE

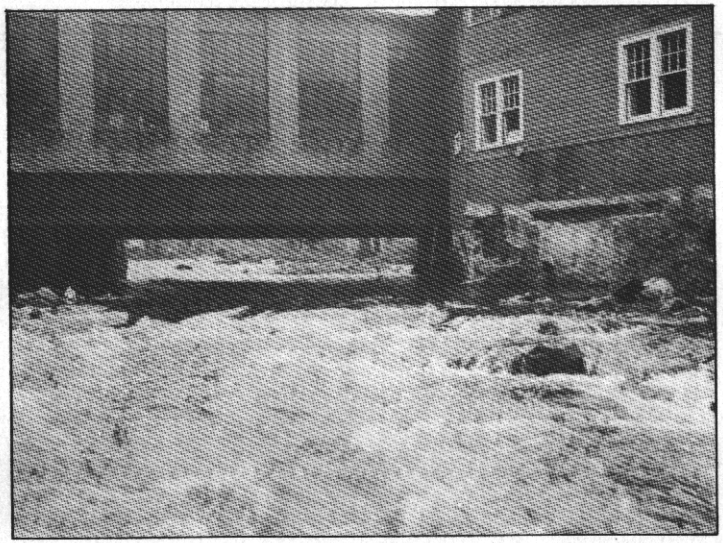


NO. 5 UPSTREAM FROM FOOTBRIDGE

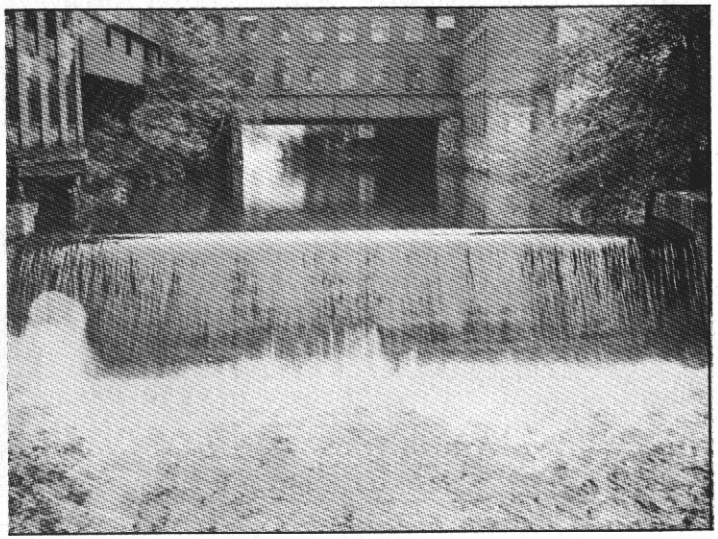


NO. 6 DOWNSTREAM FROM FOOTBRIDGE

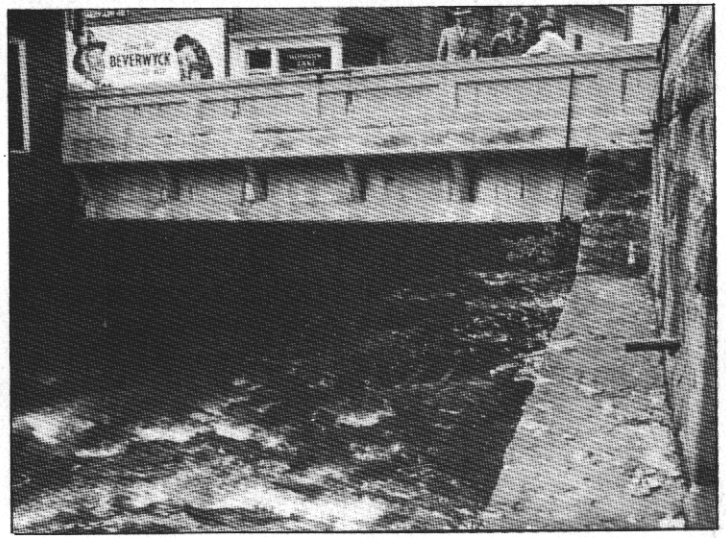
NO. 7 WINSTEAD MOTOR SALES GARAGE



NO. 8 WINSTED MOTOR SALES GARAGE

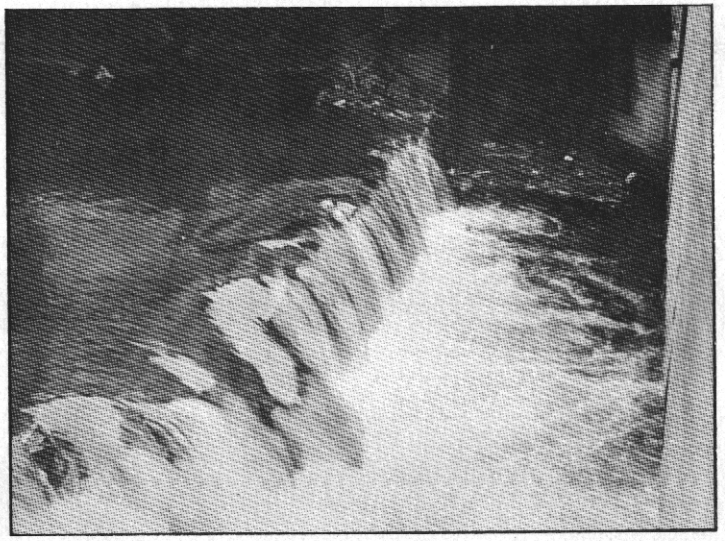


NO. 9 NEW ENGLAND KNITTING COMPANY DAM

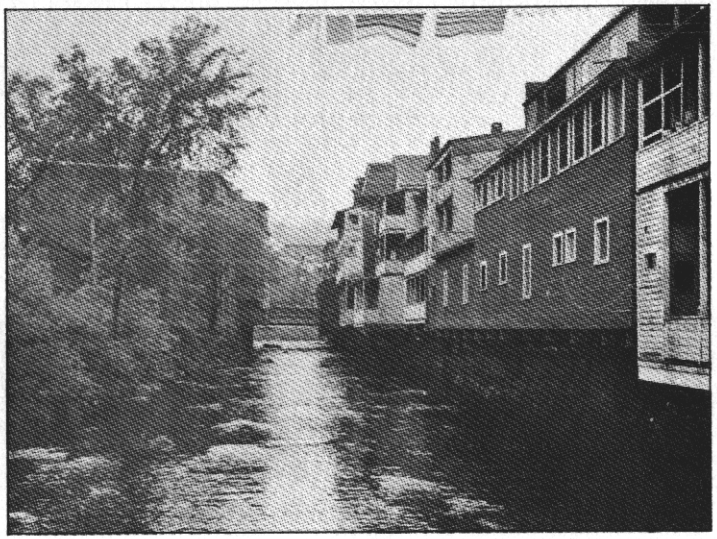


NO. 10 BRIDGE STREET BRIDGE

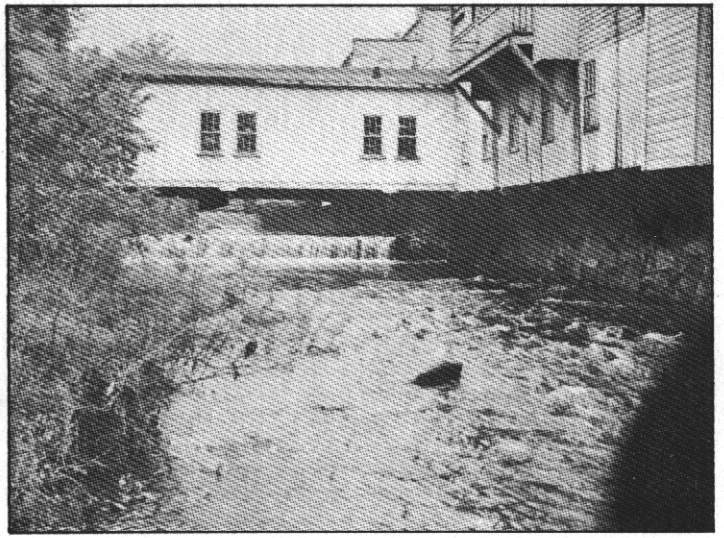
NO. 11 DOWNSTREAM FROM BRIDGE STREET BRIDGE



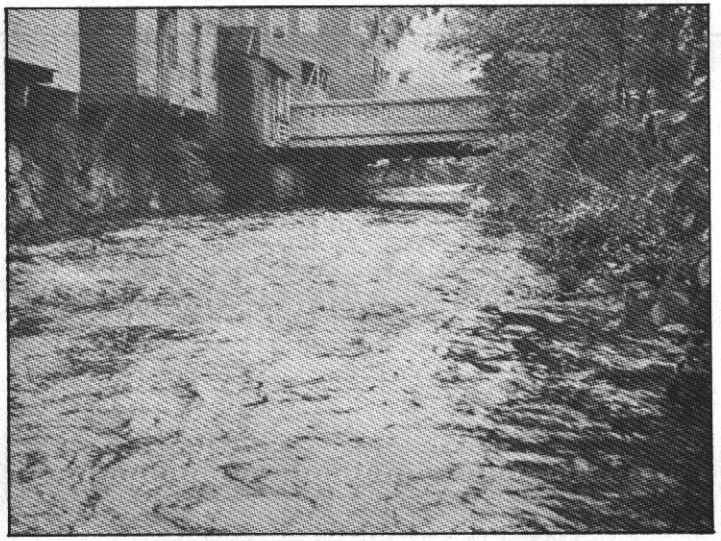
NO. 12 DAM ABOVE MADIN AND KELLY GARAGE



NO. 13 UPSTREAM VIEW



NO. 14 MADIN AND KELLY GARAGE



NO. 15 CASE AVENUE BRIDGE